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Certification Path Development Software

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Agenda

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- Overview of topologies and path development methods
- Discussion of CygnaCom's path development software
- Lessons learned developing and testing path development software
- Other path development software and development efforts

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Overview of Topologies and Path Development Methods

Definitions

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- Subscriber
  - End entity “certified” by a CA
- Trust root
  - Relying party trusts this and all entities which it has “certified”
- Certificate Path
  - Ordered list of certificates that connect a subscriber to a trust root

Trust Topologies

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- Many different PKI topologies are possible
- We'll discuss two that are easy to identify:
  - Hierarchy
  - Mesh
- Other topologies are typically a combination of those two

Hierarchy Topology

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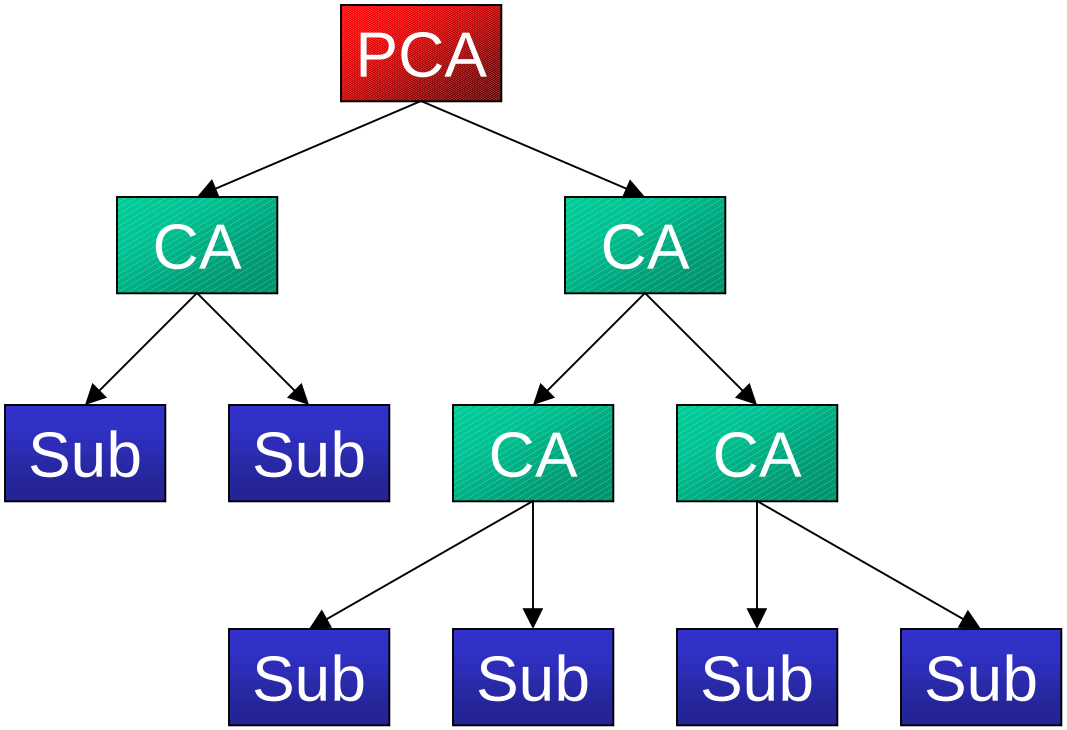

- Trust root at “top”
- Certificate issuance always one-way “down”

Mesh Topology

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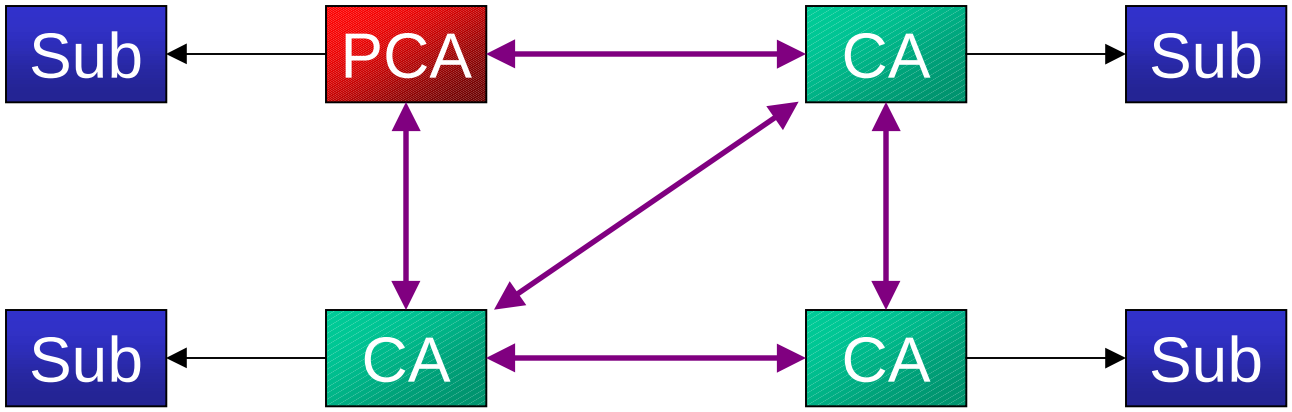

- Trust root depends on frame of reference (typically closest)
- CAs are cross-certified; subscribers have one-way issuance

Bridge CA Topology

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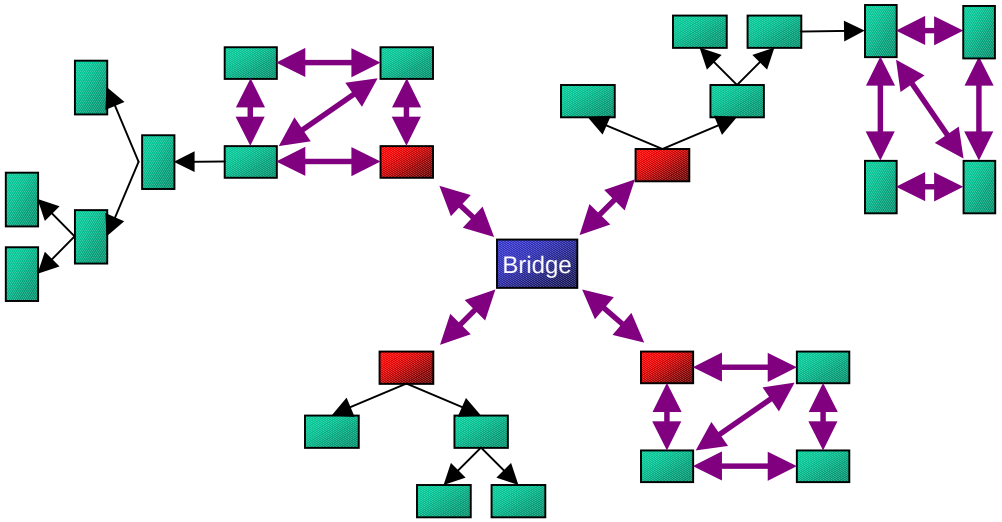
- The Bridge CA concept creates combinations of topologies which must be navigated by software



Developing Certificate Paths in a Hierarchy

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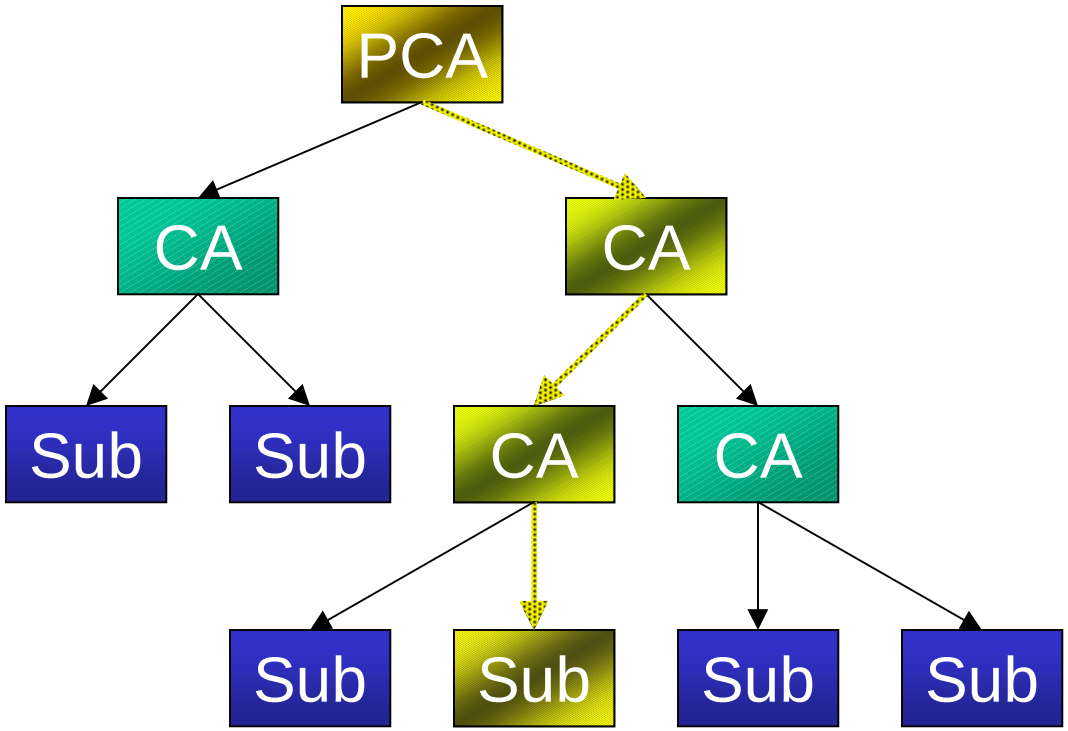
- In a hierarchy, there's only one way to go from the subscriber to the trust root: start at subscriber and follow the issuer.



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Developing Certificate Paths in a Mesh

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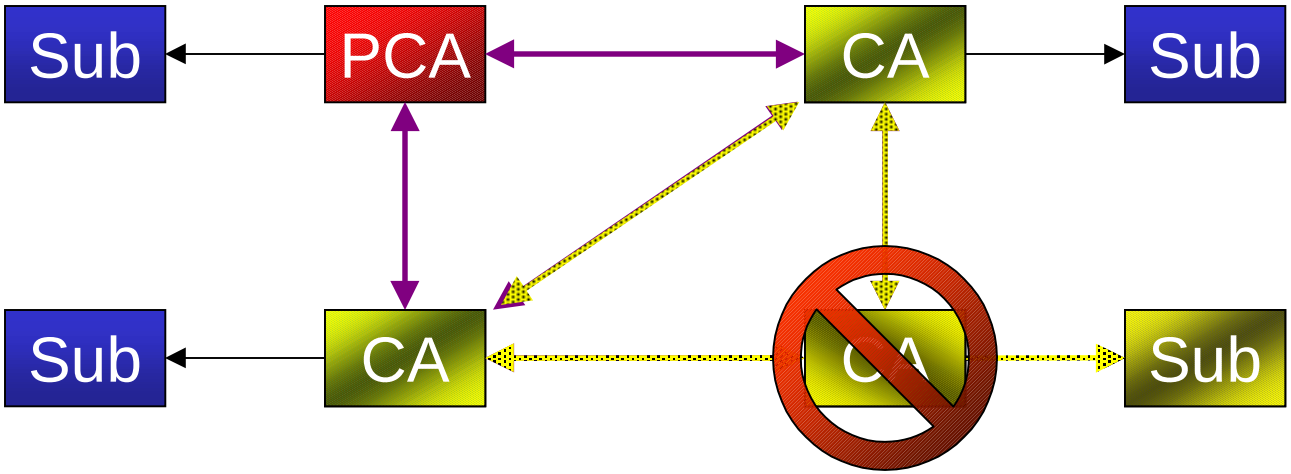
- In a mesh, it gets trickier… "follow the issuer" ends up with many choices.
- You might find loops…



Developing Certificate Paths in a Mesh

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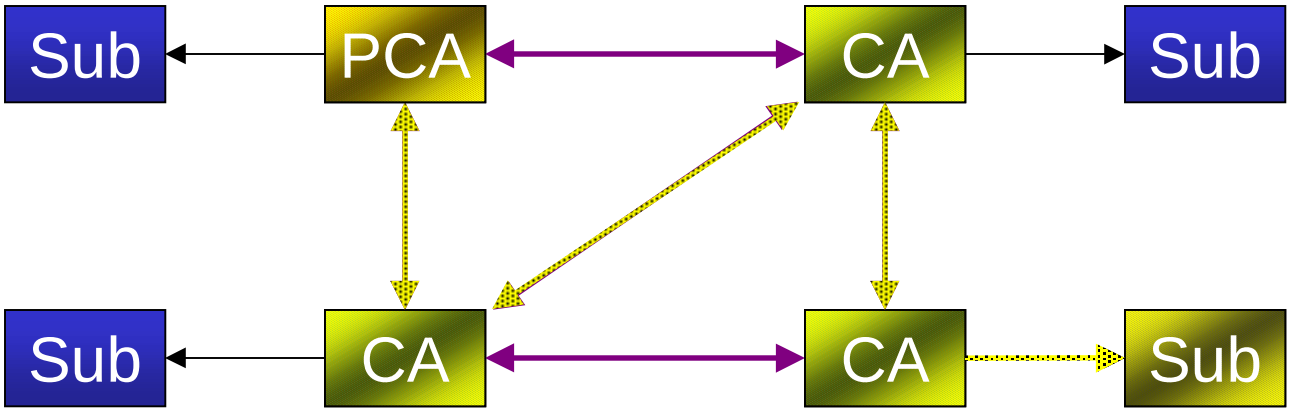
- In a mesh, it gets trickier… “follow the issuer” ends up with many choices.
- You might take a longer route…



Developing Certificate Paths in a Mesh (cont.)

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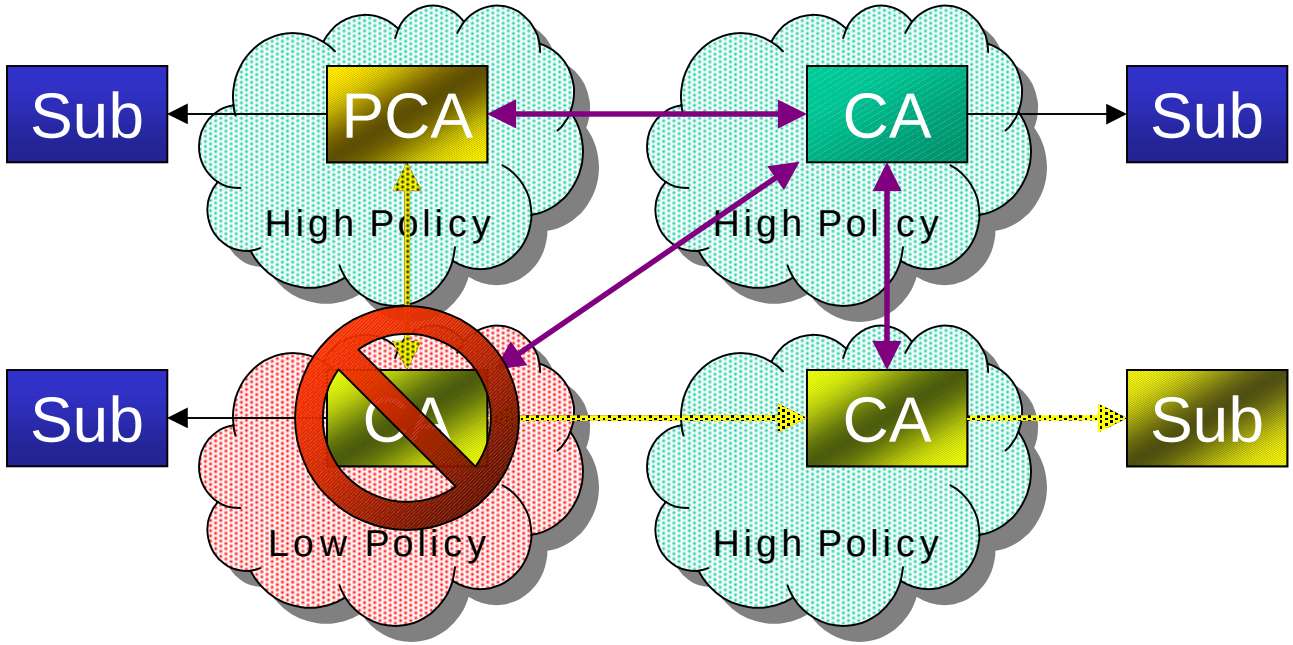
- In a mesh, it gets trickier… "follow the issuer" ends up with many choices.
- You might find invalid paths…



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Developing Certificate Paths in a Mesh (cont.)

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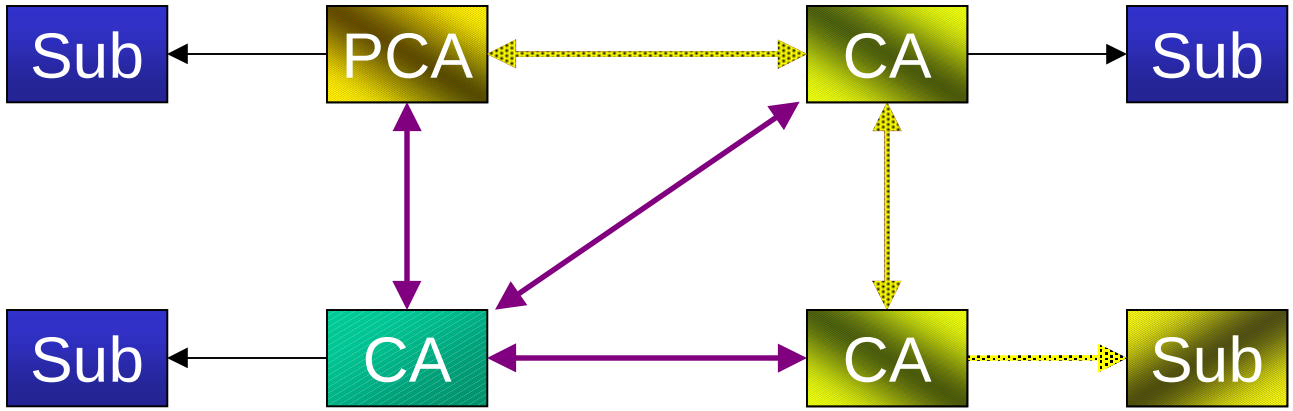
- Perhaps a better method for finding your way through a mesh is top-down…



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Overview of CygnaCom's Path Development Software

Building a tool for Certificate Path Development

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- Don't
  - restrict the topology
  - rely on a specific repository access method
  - rely on a certificate/CRL caching method
  - miss any valid paths
  - depend on a specific operating system
- Do
  - function in a Bridge CA topology
  - optimize for speed whenever possible

Building a tool for Certificate Path Development

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- Certificate Path Development Library (CPL) Architecture
  - Windows DLL, written in ANSI C++
  - Uses caller-supplied callbacks for caching and directory retrieval
- Uses bottom-up (hierarchical) approach, with some enhancements to increase our likelihood of finding a valid path
    - Matching rules
    - Certificate Sorting
    - Policy checking (via ’97 X.509)

CPL Matching Rules

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- Uses keyUsage and subjectKeyID as matching criteria (if present)
- Ensures pathToName validates at every step
- Skips invalid (expired) certificates
- Allows specification of an acceptable list of algorithms
- If initial-inhibit-policy mapping is TRUE, ensures intersection of certificatePolicies and initial-acceptable-policy-set ≠ 0

CPL Certificate Sorting

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- We retrieve all certificates for each entity in the path during development
  - userCertificate
  - cACertificate
  - crossCertificatePair
- These certificates are sorted to help us find the “right” one fastest

CPL Certificate Sorting

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- Hierarchical certificates have priority over cross certificates
- Certificates with consistent public key and signing algorithms have priority
- Certificates that assert policies in the initial-acceptable-policy-set have priority
- Certificates that assert policies should have priority
- Certificates with fewer RDN elements in the Issuer DN have priority
- Certificates with most matching RDNs between the Issuer DN and trust root DN have priority
- Certificates with most matching RDNs between the Subject DN and the Issuer DN have priority
- Certificates with longer validity periods have priority

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Lessons Learned Developing and Testing Path Development Software

Lessons Learned

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- Directory population by CA products of cross-certificates is not always done completely/correctly
  - This is hard because the forward/reverse elements need to be encoded together and posted in two separate entries
  - LDAPv2 Schema only requires forward, some software requires both

Lessons Learned (cont.)

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- Directory logs can go a long way toward helping problems be diagnosed
  - You can see the retrieval requests in order
  - This helps you determine when the retrievals stopped, if retrievals started looping, etc.

Lessons Learned (cont.)

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- As you can already tell, the directory is the key to the path development process. Make sure…
  - you have access to good directory software
  - required information is in the directory
  - you have access to people that can help with directory operations

Lessons Learned (cont.)

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- authKeyID cannot be used as a matching rule when developing paths if the **`authorityCertIssuer`** and **`authorityCertSerialNumber`** tuple is used. (Explanation follows)
- We submitted this as a defect report to ISO/ITU to get it deprecated in later versions of X.509. The editors have decided to instead add clarifying text to X.509 (2000).

Authority Key Identifier Matching Rule Defect

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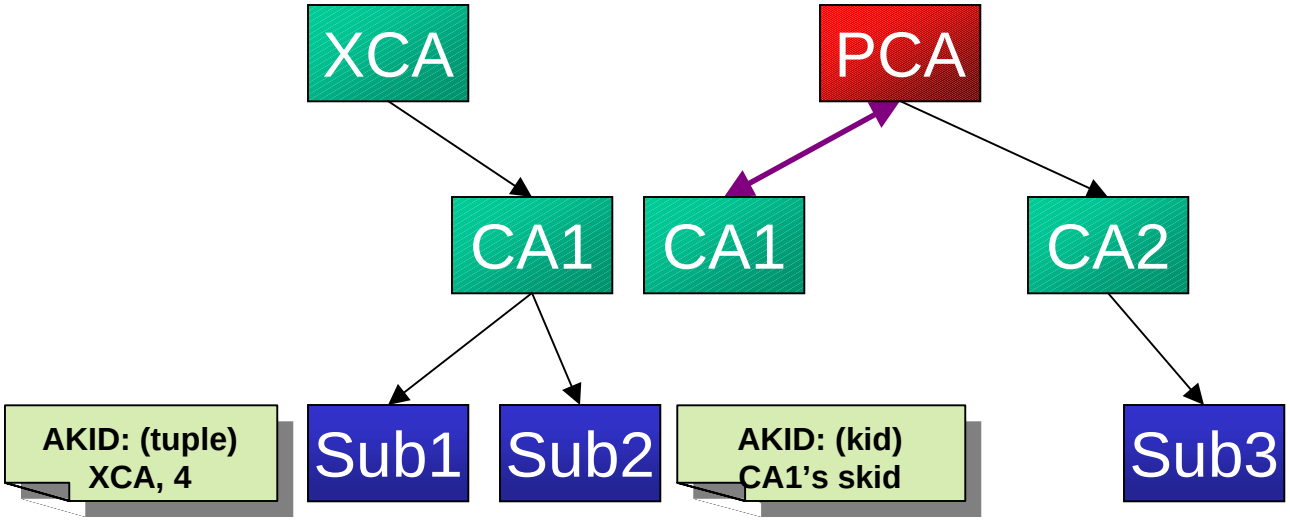

- Assuming Sub3's trust root is PCA, Sub3 will never find a path from Sub1 to PCA if AKID is used as a matching rule.
- However, Sub3 can find a path from Sub2 to PCA

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Other Path Development Software and Development Efforts

Other Path Development Software

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- As far as I know, the Entrust products are the only commercial software that can navigate complex trust paths such as these
- If I'm wrong and there are others, please let me know!
- Hopefully other commercial vendors will "jump on the bandwagon" soon

Other Development Efforts

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- The Sun Microsystems Java Community Process has just begun creation and review of the Java Certification Path API
- Sun Microsystems will be developing a reference implementation once the API is firm
- I encourage you all to join the community process and/or participate in the public comment and review of JSR-00055:

  http://java.sun.com/aboutjava/communityprocess

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Thanks for your time!

Contact me with any questions:

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